91164M

911645

2

SUPERVISOR'S USE ONLY

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Te Mātauranga Matū, Kaupae 2, 2015

91164M Te whakaatu māramatanga ki te honohono, te hanga, ngā āhuatanga me ngā huringa pūngao

9.30 i te ata Rāhina 23 Whiringa-ā-rangi 2015
Whiwhinga: Rima

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki te honohono, te hanga, ngā āhuatanga me ngā huringa pūngao.	Te whakaatu māramatanga hōhonu ki te honohono, te hanga, ngā āhuatanga me ngā huringa pūngao.	Te whakaatu māramatanga matawhānui ki te honohono, te hanga, ngā āhuatanga me ngā huringa pūngao.

Tirohia mēnā e rite ana te Tau Ākonga ā-Motu (NSN) kei runga i tō puka whakauru ki te tau kei runga i tēnei whārangi.

Me whakamātau koe i ngā tūmahi KATOA kei roto i tēnei pukapuka.

He taka pūmotu kua whakaritea ki te Rau Rauemi L2-CHEMMR.

Mēnā ka hiahia whārangi atu anō koe mō ō tuhinga, whakamahia ngā whārangi wātea kei muri o tēnei pukapuka, ka āta tohu ai i te tau tūmahi.

Tirohia mēnā e tika ana te raupapatanga o ngā whārangi 2–21 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

ME HOATU RAWA KOE I TĒNEI PUKAPUKA KI TE KAIWHAKAHAERE Ā TE MUTUNGA O TE WHAKAMĀTAUTAU.

TAPEKE

MĀ TE KAIMĀKA ANAKE

TŪMAHI TUATAHI

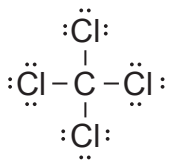
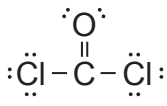
MĀ TE KAIMĀKA ANAKE

(a) Tātuhia te hanganga a Lewis (hoahoa tongi irahiko) mō ia rāpoi ngota e whai ake nei:

Te rāpoi ngota	O_2	OCl_2	CH_2O
Hanganga a Lewis			

(b) Ka taea e ngā ngota waro te hono ki ngā ngota rerekē kia puta ai ngā momo pūhui rerekē maha.

E whakaatu ana te tūtohi e whai ake i te hanganga Lewis mō ngā rāpoi ngota e rua e whai waro ana hei ngota pū, te CCl_4 me te $COCl_2$. He rerekē ngā koki hononga me ngā āhua o ēnei rāpoi ngota.

Te rāpoi ngota	CCl_4	$COCl_2$
Hanganga a Lewis		

Aromātaihia te hanganga Lewis o ia rāpoi ngota hei whakatau i te take he rerekē ngā koki hononga me ngā āhua.

I tō tuhinga me whakauru e koe:

- te koki hononga āwhiwhi i ia rāpoi ngota
- te āhua o ia rāpoi ngota
- ngā take e whakarite ai i te āhua me te koki hononga mō ia rāpoi ngota.

QUESTION ONE

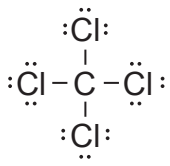
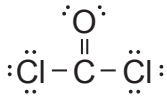
ASSESSOR'S USE ONLY

(a) Draw the Lewis structure (electron dot diagram) for each of the following molecules.

Molecule	O_2	OCl_2	CH_2O
Lewis structure			

(b) Carbon atoms can bond with different atoms to form many different compounds.

The following table shows the Lewis structure for two molecules containing carbon as the central atom, CCl_4 and $COCl_2$. These molecules have different bond angles and shapes.

Molecule	CCl_4	$COCl_2$
Lewis structure		

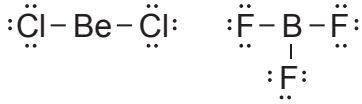
Evaluate the Lewis structure of each molecule to determine why they have different bond angles and shapes.

In your answer, you should include:

- the approximate bond angle in each molecule
- the shape of each molecule
- factors that determine the shape and bond angle for each molecule.

MĀ TE KAIMĀKA ANAKE

(c) He rerekē ngā rāpoi ngota o $BeCl_2$ me BF_3 i te mea kāore i te tino rawaka ngā irahiko mō ngā ngota pū, Be me B, kia whai anga āpiti kī. Kua whakaaturia ngā hanganga a Lewis i raro nei.



He ōrite te pitoruatanga[1] o ngā rāpoi ngota e rua.

Porohitatia te kupu e whakaahua ana i te pitoruatanga o aua rāpoi ngota.

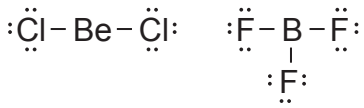
pitorua **pitokore**

Parahautia tō kōwhiringa.

[1] tōranga

ASSESSOR'S USE ONLY

(c) $BeCl_2$ and BF_3 are unusual molecules because there are not enough electrons for the central atoms, Be and B, to have a full valence shell. Their Lewis structures are shown below.



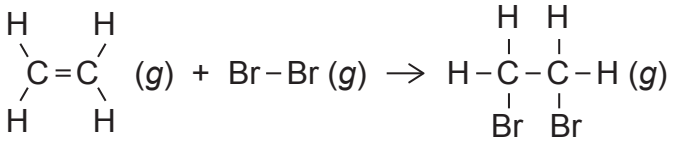
Both molecules have the same polarity.

Circle the word that describes the polarity of these molecules.

polar **non-polar**

Justify your choice.

(d) Ka tauhohe te haurehu waiwaro rua ewaro, $C_2H_4(g)$, ki te haurehu pūkane, $Br_2(g)$, e ai ki te whārite e whai ake.



Tātaihia te huringa hāwera, $\Delta_r H°$, mō te tauhohenga i waenga i ngā haurehu waiwaro rua ewaro me te pūkane, e ai ki ngā hāwera hononga toharite i roto i te tūtohi i raro.

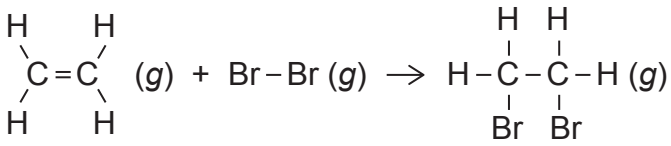
Whakaaturia katoatia ō mahinga me te whakauru i ngā wae hāngai ki tō whakautu.

Hononga	**Hāwera hononga toharite/kJ mol^{-1}**
Br–Br	193
C–C	346
C=C	614
C–Br	285
C–H	414

MĀ TE KAIMĀKA ANAKE

ASSESSOR'S USE ONLY

(d) Ethene gas, $C_2H_4(g)$, reacts with bromine gas, $Br_2(g)$, as shown in the equation below.



Calculate the enthalpy change, $\Delta_r H°$, for the reaction between ethene and bromine gases, given the average bond enthalpies in the table below.

Show your working and include appropriate units in your answer.

Bond	Average bond enthalpy/kJ mol^{-1}
Br–Br	193
C–C	346
C=C	614
C–Br	285
C–H	414

TŪMAHI TUARUA

MĀ TE KAIMĀKA ANAKE

(a) Kei roto i ngā whakamahana ringa tētahi mehanga tino pūhake rawa o te konutai ehākawa[2] (sodium ethanoate), ā, ina whakahohea, ka whātioata me te whakaputa wera.

Porohitatia te kupu e whakaahua pai ana i tēnei tauhohenga.

putawera **pauwera**

Homai tētahi pūtake mō tō kōwhiringa.

(b) (i) Whakanaohia ai te kūhuka i roto i ngā tipu i te wā o te ahotakakame ina tauhohe te hauhā[3], $CO_2(g)$, me te wai, $H_2O(\ell)$, kia puta ai te kūhuka, $C_6H_{12}O_6(aq)$, me te haurehu hāora, $O_2(g)$. Ka taea te whakaatu te tauhohenga ahotakakame mā te whārite e whai ake:

$$6CO_2(g) + 6H_2O(\ell) \rightarrow C_6H_{12}O_6(aq) + 6O_2(g) \quad \Delta_r H^\circ = 2803 \text{ kJ mol}^{-1}$$

Porohitatia te kupu e whakaahua pai ana i tēnei tauhohenga.

putawera **pauwera**

Homai tētahi pūtake mō tō kōwhiringa.

(ii) Tātaihia e hia te nui o te pūngao ka whenumitia, ka puta rānei i roto i te tauhohenga ahotakakame mēnā ka tino tauhohe te 19.8 g o te hauhā, $CO_2(g)$, ki te wai inati, $H_2O(\ell)$, kia puta te kūhuka, $C_6H_{12}O_6(aq)$, me te haurehu hāora, $O_2(g)$.

Whakaaturia katoatia ō mahinga me te whakauru i ngā wae hāngai ki tō whakautu.

$M(CO_2) = 44.0 \text{ g mol}^{-1}$

[2] konutai winika
[3] waro hāora-rua

QUESTION TWO

ASSESSOR'S USE ONLY

(a) Hand warmers contain a supersaturated solution of sodium ethanoate which, when activated, crystallises and releases heat.

Circle the term that best describes this reaction.

exothermic **endothermic**

Give a reason for your choice.

(b) (i) Glucose is made in plants during photosynthesis when carbon dioxide gas, $CO_2(g)$, and water, $H_2O(\ell)$, react to produce glucose, $C_6H_{12}O_6(aq)$, and oxygen gas, $O_2(g)$. The photosynthesis reaction can be represented by the following equation:

$$6CO_2(g) + 6H_2O(\ell) \rightarrow C_6H_{12}O_6(aq) + 6O_2(g) \quad \Delta_r H^\circ = 2803 \text{ kJ mol}^{-1}$$

Circle the term that best describes this reaction.

exothermic **endothermic**

Give a reason for your choice.

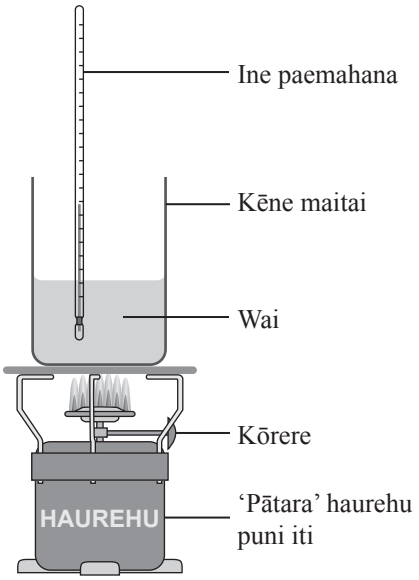
(ii) Calculate how much energy is absorbed or released in the photosynthesis reaction if 19.8 g of carbon dioxide gas, $CO_2(g)$, reacts completely with excess water, $H_2O(\ell)$, to form glucose, $C_6H_{12}O_6(aq)$, and oxygen gas, $O_2(g)$.

Show your working and include appropriate units in your answer.

$M(CO_2) = 44.0 \text{ g mol}^{-1}$

MĀ TE KAIMĀKA ANAKE

(c) Ka whakamahia tētahi tō puni iti whai haurehu pūwaro, $C_4H_{10}(g)$, ki te whakawera wai, e ai ki te hoahoa i raro. Ka inea e tētahi ākonga te huringa paemahana i roto i te wai me te tātai i te ngingiha o te pūwaro 3.65 g, ka whakaputaina te 106 kJ o te wera.



E whakaaturia ana te tauhohenga mō te ngingiha o te pūwaro ki te whārite i raro.

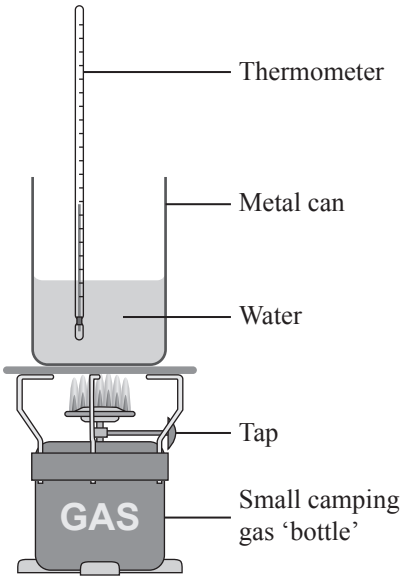
$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(\ell)$$

(i) Tātaihia te panoni hāwera noa ($\Delta_r H$) mō tēnei tauhohenga, mā te whakamahi i ngā inenga o runga.

$M(C_4H_{10}) = 58.0$ g mol^{-1}

ASSESSOR'S USE ONLY

(c) A small camp stove containing butane gas, $C_4H_{10}(g)$, is used to heat some water, as shown in the diagram below. A student measures the temperature change in the water and calculates that when 3.65 g of butane is combusted, 106 kJ of heat is released.



The reaction for the combustion of butane is shown in the equation below.

$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(\ell)$$

(i) Calculate the enthalpy change ($\Delta_r H$) for this reaction, based on the above measurements.

$M(C_4H_{10}) = 58.0$ g mol^{-1}

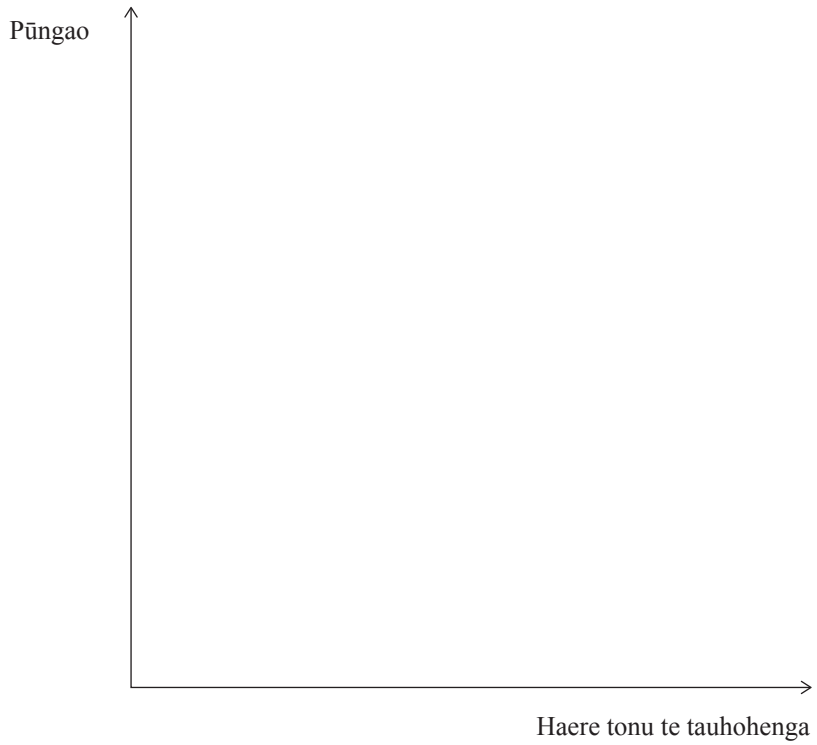
MĀ TE KAIMĀKA ANAKE

(ii) Ko te huringa hāwera e whakaaetia ana mō te tauhohenga ngingiha o te haurehu pūwaro, $C_4H_{10}(g)$, he $\Delta_r H = -5754$ kJ mol^{-1}.

Whakamāramahia te take he rerekē te otinga i tātaihia e koe i te wāhanga (c)(i) ki te uara e whakaaetia ana.

Me homai e koe ngā take e RUA neke atu rānei i tō tuhinga.

(iii) Whakaotihia, me ngā tapanga anō, te hoahoa pūngao mō te ngingiha o te haurehu pūwaro e whakaatu ana i ngā pūmatū hohe, ngā hua, me te huri o te hāwera.



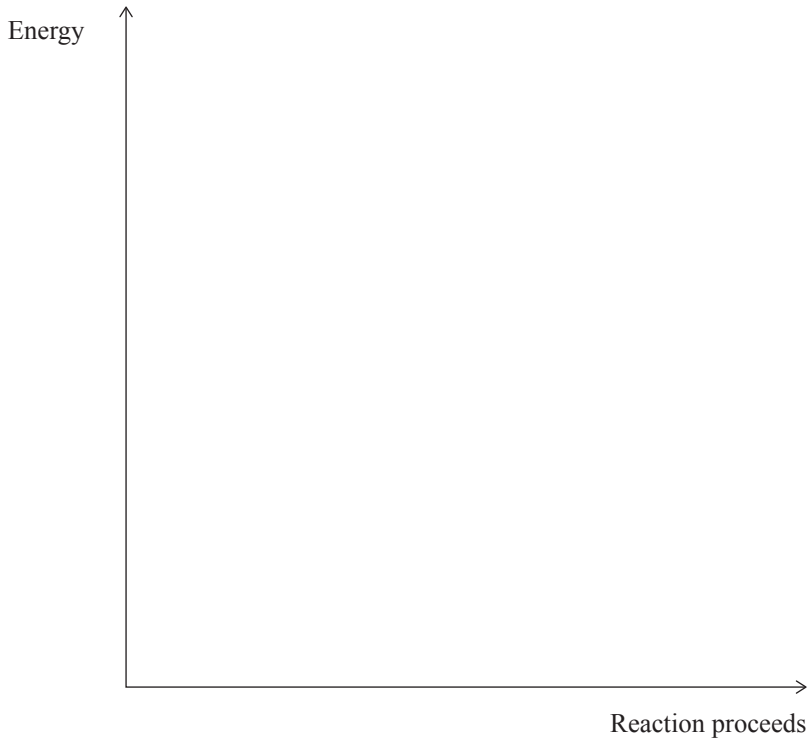
ASSESSOR'S USE ONLY

(ii) The accepted enthalpy change for the combustion reaction of butane gas, $C_4H_{10}(g)$, is $\Delta_r H = -5754$ kJ mol^{-1}.

Explain why the result you calculated in part (c)(i) is different to the accepted value.

In your answer, you should include at least TWO reasons.

(iii) Complete, including labels, the energy diagram for the combustion of butane gas showing reactants, products, and the change in enthalpy.



(iv) He kora whaitake te haurehu pūwaro i te mea ina ngingihatia, ka puta he pūngao.

Whakamāramahia te take he aha i whakaputaina ai he pūngao i tēnei tauhohenga, e ai ki te waihanga me te wāwāhi hononga.

Kāore e hiahiatia ana he tātaitanga.

MĀ TE KAIMĀKA ANAKE

(iv) Butane gas is a useful fuel because when it undergoes combustion, energy is released.

Explain why energy is released in this reaction, in terms of making and breaking bonds.
No calculations are required.

ASSESSOR'S USE ONLY

TŪMAHI TUATORU

MĀ TE KAIMĀKA ANAKE

(a) Whakaotihia te tūtohi i raro mā te kī mai i te momo totoka, te momo korakora kei roto, me ngā tōpana kume i waenga i ngā korakora i ia totoka.

Totoka	Tūmomo totoka	Tūmomo korakora	Ngā tōpana kume i waenga korakora
Cu(*s*) (konukura)			
$PCl_3(s)$ (pūtūtaewhetū pūhaumāota-toru)			
$SiO_2(s)$ (takawai hāora-rua)			
KCl(*s*) (konurehu pūhaumāota)			

(b) He wē i te paemahana rūma te pūtūtaewhetū pūhaumāota-toru, PCl_3, ā, kāore e kawe hiko ana.

Whakamāramahia mai ēnei kitenga e rua e ai ki ngā korakora, hanganga, me te honohono o te PCl_3.

QUESTION THREE

ASSESSOR'S USE ONLY

(a) Complete the table below by stating the type of solid, the type of particle, and the attractive forces between the particles in each solid.

Solid	Type of solid	Type of particle	Attractive forces between particles
Cu(*s*) (copper)			
$PCl_3(s)$ (phosphorus trichloride)			
$SiO_2(s)$ (silicon dioxide)			
KCl(*s*) (potassium chloride)			

(b) Phosphorus trichloride, PCl_3, is a liquid at room temperature, and does not conduct electricity.

Explain these two observations in terms of the particles, structure, and bonding of PCl_3.

(c) Whakaarohia ia totoka o te konukara, Cu, takawai hāora-rua, SiO_2, me te konurehu pūhaumāota, KCl.

MĀ TE KAIMĀKA ANAKE

Whakaotihia te tūtohi i raro mā te tautohu kei ēhea o ēnei totoka ngā āhuatanga ōkiko e rārangitia ana.

Ngā āhuatanga ōkiko	Totoka
Kāore te totoka e rewa i roto i te wai, ā, he māngohe.	
He rewa te totoka i roto i te wai, ā, ehara i te māngohe.	
Kāore te totoka e rewa i roto i te wai, ā, ehara i te māngohe.	

Parahautia ō kōwhiringa e RUA e ai ki ngā korakora, hanganga, me te hononga o ēnei totoka. Ka whakaaetia te whakamahi hoahoa hei tautoko i tō tuhinga.

ASSESSOR'S USE ONLY

(c) Consider each of the solids copper, Cu, silicon dioxide, SiO_2, and potassium chloride, KCl.

Complete the table below by identifying which of these solids have the listed physical properties:

Physical properties	Solid
The solid is insoluble in water and is malleable.	
The solid is soluble in water and is not malleable.	
The solid is insoluble in water and is not malleable.	

Justify TWO of your choices in terms of the particles, structure, and bonding of these solids. You may use diagrams in your justification.

He whārangi anō ki te hiahiatia.
Tuhia te (ngā) tau tūmahi mēnā e tika ana.

TAU TŪMAHI

MĀ TE KAIMĀKA ANAKE

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

ASSESSOR'S USE ONLY

English translation of the wording on the front cover

Level 2 Chemistry, 2015

91164M Demonstrate understanding of bonding, structure, properties and energy changes

9.30 a.m. Monday 23 November 2015
Credits: Five

91164M

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of bonding, structure, properties and energy changes.	Demonstrate in-depth understanding of bonding, structure, properties and energy changes.	Demonstrate comprehensive understanding of bonding, structure, properties and energy changes.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

A periodic table is provided on the Resource Sheet L2–CHEMMR.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–21 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.